FINAL GROUNDWATER/SURFACE WATER INVESTIGATION PLAN (GSIP) STATEMENT OF WORK (SOW)

INTRODUCTION

The purpose of this Final GSIP SOW is to address EPA's GSIP Phase 1 and Phase 2 comments and satisfy the obligations of the ROD and Consent Decree. The information gathered in the Final GSIP SOW shall be incorporated into a Final Comprehensive GSIP Report. All applicable, relevant and appropriate data from the GSIP Phase 1 and Phase 2 Reports shall be incorporated into this Final Comprehensive GSIP Report, as well as any other relevant and appropriate data such as the 1993 Geraghty & Miller groundwater data, MIT data, etc. The previous GSIP Phase 1 and 2 human health and ecological risk assessments shall be revised based upon the data generated from the Final GSIP SOW and any applicable, relevant and appropriate data generated since the GSIP Phase 2 Report. The revised human health and ecological risk assessments will comply with current EPA guidance/ policy requirements and be incorporated into the final section of the Final Comprehensive GSIP Report. The work outlined in this Final GSIP SOW is being required under the Industri-Plex Superfund Site, Woburn, MA, Consent Decree (US EPA Civil Action # 89-0195-MC) lodged April 24, 1989. EPA will conduct field oversight of the Final GSIP SOW investigation activities.

Section 1.0 On-Site Investigations

Section 1.1 Source Areas (Southern Atlantic Avenue/Vining Property, West Hide Pile)

The approach outlined in ISRT's November 11, 1997 Source Area Scope of Work appropriately evaluates the West Hide Pile and Southern Atlantic Avenue /Vining Property. Attached EPA has provided specific comments to this work plan. These comments must be satisfactorily addressed and incorporated into the revised work plan. The investigation will determine the condition of the benzene and toluene source contamination and evaluate possible removal of the source. This approach agrees with EPA's requirement to assess the impact of source areas and is consistent with EPA's March 6, 1998 Draft SOW. EPA will provide field oversight of the investigation activities. Consistent with the November 1997 Commerce Way Source Area Investigation, ISRT, EPA, and their respective contractors will maintain direct communication through-out the investigation, and evaluate any modifications associated with anomalies or unanticipated events.

Section 1.2 Groundwater Flow Path

Section 1.2.1 Buried Aquifer Conditions (Hide Piles to HBHA Pond)

Additional investigation work will be accomplished in a 2-step approach.

Step 1

OPTION A:
Collect low-flow groundwater samples from the shallow, intermediate and deep portions of the overburden aquifer at the 45 sampling locations delineated on Figure 1. The Figure illustrates 9 transects with five sampling locations per transect. These samples will be analyzed for "Plume Delineation Parameters" illustrated on Table 1. A total of 135 samples will be collected plus QA/QC samples (trip blanks, duplicates, equipment blanks). If the total arsenic analysis shows concentrations greater than 50 mg/l then the laboratory will be instructed to continue analysis to determine arsenic speciation.

All samples will be collected with a peristaltic pump following EPA-Region 1 Low Flow Sampling Standard Operation Procedures (SOP). Metals and Arsenic Speciation Samples should be properly preserved in accordance with EPA/ISRT April/May 1998 discussions [1) samples are to be stored at the temperature they were collected at; 2) HCl will be used as a preservative, 3) amber bottles will be used and samples will be kept in the dark].

OPTION B:

Collect low-flow groundwater samples from shallow, intermediate and deep portions of the overburden aquifer at the 45 sampling locations delineated on Figure 1. The Figure illustrates 9 transects with five sampling location per transect. These samples will be analyzed in the field through "Field Screening Parameters" illustrated on Table 2. A total of 135 samples will be collected in the field. If the total arsenic analysis shows concentrations greater than 50 mg/l then the sample will be sent off-site to a certified laboratory for total arsenic and arsenic speciation.

All samples will be collected with a peristaltic pump following EPA-Region 1 Low Flow Sampling Standard Operation Procedures (SOP). In order to check the accuracy and precision of the field analysis, 15% of the samples (approximately 20 samples) shall be analyzed for the Chemical Parameters listed in Table 2 Field Groundwater Analytical Parameters. All metal and Arsenic Speciation Samples for laboratory analysis should be properly preserved in accordance with EPA/ISRT April/May 1998 discussions [1) samples are to be stored at the temperature they were collected at; 2) HCl will be used as a preservative, 3) amber bottles will be used and samples will be kept in the dark].

Step 2

Based on these data, the core of the plume will be mapped both vertically and horizontally. One sampling location will be selected at each of the nine transects, based upon the highest concentrations of arsenic, benzene, and toluene observed in Step 1. The decision for selecting the sampling location should also take into consideration the field geo-chemistry

data and their impact on the plumes. Three samples will be collected from each sampling location (shallow, intermediate and deep) and analyzed for "Plume Geochemistry Parameters" illustrated on Table 1. A total of 30 samples will be collected plus QA/QC samples (trip, blanks, duplicates, equipment blanks, etc). Samples will be collected using EPA Region I low-flow techniques and analyzed by a certified laboratory.

Section 1.2.2 Bedrock Aquifer

The potential for bedrock contamination and migration have not been thoroughly evaluated at the Site. Although, EPA is willing to consider ISRT's current evaluation of bedrock, which suggests that the bedrock does not significantly contribute to flow in the overburden aquifer or to the HBHA Pond and HBHA Wetlands. However, if new groundwater data collected in the overburden suggests that the above is not accurate, then additional bedrock data may be required. See related work under Section 2.2.

Section 2.0 Off-Site Investigations

Section 2.1 Source Areas

Other sources may also be contributing to the release of site-related contaminants (e.g. arsenic) in groundwater. These source areas include the western and eastern portion of the Boston Edison ROW Number 9, which were was remediated as part of the remedial action, the former Mishawum Lake bed sediments containing high concentrations of metals, and HBHA Wetland sediments. All of these areas contain site related COCs, and organic materials which may generate geochemical conditions in groundwater that may cause the mobilization of site related metals. Groundwater data collected in 1993 show high arsenic concentrations in groundwater being released from the western portion of BECO ROW, which contains site-related animal hide waste materials. These same releases are expected to be occurring at the eastern portion of the ROW, which also contains site-related animal hide waste materials. Through precipitation and erosion events and possible contaminant groundwater discharge, the Mishawum Lake bed sediments and HBHA sediments also received site related contaminants. The following investigations will be required at each potential source area:

Section 2.1.1 Source Plume Delineation

Section 2.1.1.1 Western and Eastern BECO ROW Section

Three groundwater monitoring transects (transect #s 3, 4 and 5) containing a total of thirteen sample locations, as shown on Figure 2, shall be located immediately downgradient of this area to evaluate the source. Low flow groundwater samples will be collected from each of three vertical horizons of the aquifer (shallow, intermediate, and deep) at each location and analyzed for Table 1 "Plume Delineation Parameters". A total of 39 samples will be collected plus QA/QC samples (trip

blanks, duplicates, equipment blanks). All samples will be collected with a peristaltic pump following EPA-Region 1 Low Flow Sampling Standard Operation Procedures. See GW Notes 1 and 2 below.

Section 2.1.1.2 Former Mishawum Lake Groundwater

One groundwater monitoring transect (transect # 2) containing five (5) sampling locations, as shown on Figure 2, shall be located immediately downgradient of this area to evaluate the source. Low flow groundwater samples will be collected at each locations at a vertical frequency of no-less-than every 10 feet, and analyzed for Table 1 "Plume Delineation Parameters". It is estimated that the saturated thickness of the overburden aquifer is 80 feet. In preparation of cost information, it is estimated that a total of 40 samples will be collected plus QA/QC samples (trip blanks, duplicates, equipment blanks). All samples will be collected with a peristaltic pump following EPA-Region 1 Low Flow Sampling Standard Operation Procedures. See GW Notes 1 & 2 below.

Section 2.1.2 Comprehensive Source Core/Maximum Concentration Delineation

Based upon the results of Section 2.1.1 and Section 2.2, 26 samples (approximately 20% of the total samples) will be collected from the four areas (Western BECO ROW, Eastern BECO ROW, Former Mishawum Lake, HBHA Pond Buried Valley) and be analyzed for "Plume Geochemistry Parameters" illustrated on Table 1. Samples will be selected from each transect based upon the maximum concentrations site-related contaminates. A minimum of 50% of the samples (13 samples) will be proportionately collected from each transect within the four areas, in an attempt to map the core of the plume(s). As appropriate (where no plume core exists), other samples may be selected based upon maximum concentrations. In addition, appropriate QA/QC samples (trip blanks, duplicates, equipment blanks) will be collected. All samples will be collected with a peristaltic pump following EPA-Region 1 Low Flow Sampling Standard Operation Procedures.

Section 2.1.3 Potable Drinking Water Supply (Interstate 95)

One groundwater monitoring transect (transect # 1) containing seven (7) sampling locations shall be located just north of Interstate 95 as illustrated on Figure 2 to evaluate the sources. Low flow groundwater samples will be collected at each locations at a vertical frequency of no-less-than every 10 feet, and analyzed for Table 1 "Plume Geo-Chemistry Parameters". It is estimated that the saturated thickness of the overburden aquifer is 80 feet. In preparation of cost information, it is estimated that a total of 56 samples will be collected plus QA/QC samples (trip blanks, duplicates, equipment blanks, etc). All samples will be collected with a peristaltic pump following EPA-Region 1 Low Flow Sampling Standard Operation Procedures. See GW Notes 1 & 2 below.

Section 2.1.4 Mishawum Lake Bed Sediments

Twenty soil borings shall be located within and adjacent to the Former Mishawum Lake boundary to determine the presence of site-related contaminants. Borings will be located on an approximate 300 to 400 foot grid as shown on Figure 3. One composite sample will be collected from a 2-foot interval that spans the original lake bed sediment/peat layer and analyzed for TAL metals. If field X-Ray Fluorescence can detect metal compounds to MCP and Consent Decree Soil action levels (such as, As=30 ppm, Cr=1,000 ppm, Pb=300 ppm, Hg = 20 ppm, etc.), then the technology should be utilized in the field with 20% of the samples being submitted to a certified laboratory for confirmatory analysis. In addition, the samples will also be analyzed for site related semi-volatile contamination (Bis(2-ethylhexyl)phthalate, Diethylphthalate, PAHs, 4-Methyl-2-pentanone, and 4-methylphenol). The results of this work will be applied to future human exposure pathways (e.g. construction worker).

GW NOTE 1: Horizontally, the sample locations shall be located approximately 150 - 200 feet apart, as illustrated on the Figures.

GW NOTE 2: Hydro-punch monitoring well techniques (e.g. micro-wells, geo-probes, etc.) are considered the most cost effective means at obtaining low-flow groundwater information; however, field conditions or equipment limitations may cause other monitoring well techniques to be more cost effective. ISRT and EPA should discuss these other monitoring well techniques when field conditions or equipment limitation issues arise. Where applicable, these other techniques may be implemented.

Section 2.2 HBHA Pond Buried Valley Groundwater Flow Paths

Two groundwater monitoring transects containing thirteen (13) sampling locations shall be installed at the southern end of HBHA Pond and south of the HBHA Pond as shown on Figure 4 to evaluate the plumes migration . Low flow groundwater samples will be collected at each locations at a vertical frequency of no-less-than every 10 feet, and analyzed for Table 1 "Plume Delineation Parameters". It is estimated that the saturated thickness of the overburden aquifer is 40 feet. In preparation of cost information, it is estimated that a total of 52 samples will be collected plus QA/QC samples (trip blanks, duplicates, equipment blanks). All samples will be collected with a peristaltic pump following EPA-Region 1 Low Flow Sampling Standard Operation Procedures. See GW Notes 1 and 2 below.

GW NOTE 1: Horizontally, the sample locations shall be located approximately 150 - 200 feet apart, as illustrated on the Figures.

GW NOTE 2: Hydro-punch monitoring well techniques (e.g. micro-wells, geo-probes, etc.) are considered the most cost effective means at obtaining low-flow groundwater information; however, field conditions or equipment limitations may cause other monitoring well techniques to be more cost effective. ISRT and EPA should discuss these other monitoring well techniques when field

conditions or equipment limitation issues arise. Where applicable, these other techniques may be implemented.

Section 2.3 Ecological and Human Health Impact

Section 2.3.1 Toxicological Surface Water and Sediment Sampling

EPA is requiring that comprehensive sediment and surface water toxicity data be collected for the site to properly assess ecological impacts related to site-related contaminated sediments and surface water. EPA's triad sediment sampling analysis approach shall be applied for each of the thirteen sediment samples collected from locations shown on Figure 5. Analytical parameters for sediment samples will be VOCs, metals, and SVOCs, as well as PCBs and pesticides. In addition, macro-invertebrate samples shall be collected at each of these sediment locations and analyzed qualitatively for species and quantitatively for contaminant concentrations. Qualitative analysis will identify type of organisms/species, and number of organisms/species at each of the 13 sediment sample locations. Quantitative benthic analysis will also be conducted at each of the 13 sediment sampling locations, and analyzed for metals at a experienced, certified laboratory. Acute and chronic toxicity testing will be performed on hyalella and chironomids as the indicator species at each of the 13 sediment sampling locations. A copy of the chronic toxicity Standard Operating Procedures for hyalella is attached. The data collected will be applied to human health and ecological risk assessments, and utilized in food chain models to evaluate the impact to the mallard duck.

Section 2.3.2 Fish Sampling

Additional fish samples shall be collected to further evaluate the impacts to fish from the site-related contaminants qualitatively and quantitatively. Previous fish sampling activities have illustrated a depleted fish population in the HBHA Pond. This depletion appears to be associated with the presence of site related contaminants in the HBHA Pond and contaminant plume discharges into the HBHA Pond. This additional sampling will be conducted in four ponds near the Site (two downgradient and two upgradient) and the data will be applied to the human health and ecological risk assessments. These Ponds are identified as North Pond, Phillips Pond, HBHA Pond, and HBHA Wetland pond 3 at Mishawum Road. See Figure 5 for fish sampling locations.

The fish samples collected at the reference stations should reflect species collected at the downgradient ponds (HBHA Pond and HBHA Wetland Pond 3). Therefore, fish should be collected from the downgradient ponds first. All fish sampling activities shall comply with EPA's "Guidelines for Fish Tissue Preparation and Analyses" (1995).If possible, a minimum of five fish from each of three trophic species (predator, forager, bottom feeder) should be collected. The variety of species should be representative of different trophic levels. Prior

to preparing the fish for tissue analysis, the fish will be examined for histological effects from potential contaminant exposure. The USFWS, with assistance from the Contractor, will collect the fish species, and assist in documenting qualitative fish observations (species; number of fish collected of each species; age; length; weight; visual observation, such as tumors, sores lesions, etc; fish collection technique; other environmental observations surrounding sampling area; etc.,). Documentation will also include photographing the fish species. A log will be kept by the USFWS and the Contractor to document these observations. The Contractor shall quantitatively prepare the fish for laboratory analysis. The fish will be analyzed for tissue analysis as follows:

small fish:	analyze whole fish for metals
medium fish:	analyze offal and fillet for metals
large fish:	analyze target organs (liver and kidneys) for metals

The USFWS and contractor will also evaluate the four ponds ability to provide a sustainable fish population that supports recreational fishing. This evaluation will be considered in the human health risk assessment.

Section 2.4. Downgradient Transport

Section 2.4.1 Sediments

The purpose of this work is to determine the hydraulic characteristics of the HBHA (Pond and Wetlands) over a range of discharge scenarios; to identify sediment physical characteristics to quantify entrainment shear stresses, transport mechanisms, and depositional dynamics; and to quantify sediment loading, retention, and export budgets for HBHA under normal and high-flow conditions.

The objectives will be accomplished by:

1) Obtaining the HEC-2 data deck used in the 1980 FEMA study to evaluate velocity and discharge profiles through HBHA. Note: This study should consider that significant changes to the surface water conditions at/surrounding the site have occurred since the 1980 FEMA study.)

2) Collecting depth integrated stream sediment samples and concurrent velocity and depth measurements at all HBHA inflows and outflows.

3) Determining the volume, chemical composition, and physical characteristics of fine-grained sediments in HBHA.

4) Completing investigations to determine sediment contaminant flux migration, contaminant migration under storm conditions, and sediment migrations mechanisms.

5) Determining the storm size required to mobilize and transport HBHA Pond sediments downstream.

6) Completing a hydraulic and sediment fate and transport modeling analysis of the HBHA.

See related work under Section 2.4.2.

Section 2.4.2 Surface Water

To understand sediment transport and impacts to surface water, the following investigation will be conducted in 2 steps:

Step 1

- Using depth integrated samplers, TSS samples will be collected from nine sampling locations to determine the optimum sampling depths. The nine sampling locations will include:

  - Halls Brook discharge into HBHA Pond;
  - Atlantic Avenue Drainway discharge into HBHA Pond;
  - Unnamed tributary draining BECO ROW 9 and discharging into HBHA Pond;
  - Discharge from HBHA Pond;
  - Discharge from HBHA Wetland; and
  - 4 Culverts draining areas west of the commuter rail tracks and discharging into HBHA Wetland (samples may need to be collected as grab samples).

Step 2

- Determine the stage response and use the information to set the proper sample depth of the ISCO sampler units.

- Install storm-activated ISCO samplers at each of the nine sampling locations. If Step 1 indicates that the data from the four western culverts is inconsequential, then the ISCO samplers may be located at the five sampling locations along HBHA. Grab samples may be collected where ISCO samplers are not implemented.

1. Collect time interval TSS samples during base flow and two storm flow periods during the spring, and pond turn over periods (mid summer/ early fall and late fall/winter) at the 9 locations (listed above).

2. Prepare 81 flow weighted composite samples (three seasons, 3 sampling events per seasons and 9 sampling locations); analyze each sample for TSS, total Arsenic, Dissolved Arsenic, (determine suspended arsenic by difference), total chromium, total lead, total mercury, Bis(2-ethylhexyl)phthalate, Diethylphthalate, PAHs, 4-Methyl-2-pentanone, and 4-methylphenol.

3. Prepare 9 flow weighted composite samples of the discharge from HBHA Pond (3 seasons and three sampling events per season); analyze the samples for TCL VOCs, TCL SVOCs, and TAL metals.

4. Prepare 9 flow weighted composite samples of the discharge from HBHA Wetland (3 seasons and three sampling events per season) analyze the samples for TCL VOCs and TCL SVOCs and TALS metals.

- Collect stage discharge relationship data during rain events from each of the nine sampling locations.

- Collect discharge measurements from each of the nine sampling locations .

See related work under Section 2.3.1 and Section 2.4.1.

Section 2.4.3 Monthly Surface Water Monitoring

The contractor shall collect monthly surface-water samples for one year (12 months) at the HBHA Pond outlet and HBHA Wetland (Mishawum Road) outlet, and analyze these samples for toluene, benzene, arsenic (total and dissolved), chromium (total), lead (total), mercury (total), iron (total) and geochemistry parameters. As necessary, vertical profiling and/or cross-sectional surface water samples may need to be collected from each outlet to determine adequate sampling/monitoring locations. This effort can be combined with additional surface water sampling efforts outlined under Section 2.4.2.

Section 2.5 Risk Assessments

Section 2.5.1 Human Health Risk Assessment*

The human health risk assessment must be revised based upon the new analytical data, and comply with EPA guidance documents and GSIP comments. Groundwater exposure scenarios are to include the commercial or industrial use of groundwater, VOC vapor

intrusions into building spaces, and construction worker exposure to groundwater. Surface water exposure scenarios are to include wading and swimming in HBHA and ingestion of fish. The surface water exposure scenario must also consider contaminated groundwater discharging to surface water. Soil exposure scenarios are to include construction worker exposure to contaminated soils/sediments as seen at the former Mishawum Lake bed sediments.

Section 2.5.2 Ecological Risk Assessment*

The ecological risk assessment must be revised based upon the new analytical data, and comply with EPA guidance documents and GSIP comments.

* EPA has included a copy of EPA Region 1, New England, Risk Updates (Numbers 1 - 4). Also, on December 17, 1997, EPA released "Risk Assessment Guidance for Superfund (RAGS) Volume 1 - Human Health Evaluation Manual (part D, Standardized Planning, Reporting, and Review of Superfund Risk Assessments) (Interim)". Please reference these documents, as well as any other applicable guidance documents, when preparing the risk assessments.

TABLE 1
Groundwater Analytical Parameters*

Plume Delineation Parameters

Field Parameters: Eh, pH, temperature, Specific Conductance, Dissolved Oxygen, Ferrous Iron, Sulfide

Laboratory: Low-Flow Sampling - Unfiltered Samples; Alternatively, Unfiltered and Filtered Samples

Benzene
Toluene
Total Arsenic
Arsenic Species**
Total Iron
Total Chromium
Total Lead
Total Mercury

Plume Geochemistry Parameters

Field Parameters: Eh, pH, temperature, Specific Conductance, Dissolved Oxygen, Ferrous Iron, Sulfide

Laboratory:

TCL VOCs	(Low-Flow Sampling - Unfiltered Samples; Alternatively, Unfiltered and Filtered Samples)
TAL Metals	Low-Flow Sampling - Unfiltered Samples; Alternatively, Unfiltered and Filtered Samples)
TCL SVOCs	(Low-Flow Sampling - Unfiltered Samples; Alternatively, Unfiltered and Filtered Samples)

Arsenic Species**
Nitrate, Nitrite, Sulfate, Bicarbonate/Carbonate and Phosphate
Ammonia
DOC

* In addition to the groundwater samples, the contractor shall collect appropriate Quality Assurance and Quality Control (QA/QC) samples for laboratory analysis. This includes trip blanks, duplicates, equipment blanks, etc.

** Arsenic Speciation will be conducted only when Total Arsenic concentrations are greater than 50 ppb.

TABLE 2
Field Groundwater Analytical Parameters*

Field Screening Parameters

Geochemistry Parameters: Eh, pH, temperature, Specific Conductance, Dissolved Oxygen, Ferrous Iron, Sulfide

Chemical Parameters: On-Site GC, or similar field instrument; Low-Flow Sample Collection

Benzene
Toluene
Total Arsenic
Arsenic Species**
Total Iron
Total Chromium
Total Lead
Total Mercury

* In addition to the groundwater samples, the contractor shall collect appropriate Quality Assurance and Quality Control (QA/QC) samples for laboratory analysis. This includes trip blanks, duplicates, equipment blanks, etc.

** Arsenic Speciation will be conducted only when Total Arsenic concentrations are greater than 50 ppb.

NATURAL ATTENUATION STUDY
STATEMENT OF WORK

Section 1.0 HBHA Pond

The geochemical conditions, fate and transport of contaminants and natural attenuation mechanisms may cause metals to potentially release into ground water and surface water. These processes must be evaluated to determine their impact on migration, and if the conditions causing or arresting migration are permanent or reversible. This SOW will focus on understanding the natural attenuation mechanism within the HBHA Pond.

Representative sediment samples will be collected from 21 locations (7 transects; 3 samples/transect) within the HBHA Pond as shown on Figure 1. Representative sediment samples will be collected with minimal disturbance to the sample and be analyzed for NAS Table 1 Sediment Delineation Parameters.

Based upon the results of the initial 21 sediment samples, 7 representative sediment samples will be collected by inert sampling procedures and analyzed for NAS Table 1 Sediment Geochemistry Parameters.

Based upon the results of the initial 21 sediment samples, 7 representative sediment samples will be collected by inert sampling procedures to conduct batch arsenic adsorption tests using As (III) and the solids separated from each sample, and analyze pore water separated from each sample for As (III), As (V) and Organic Arsenic.

Based upon the results of the initial 21 sediment samples, 3 representative sediment samples containing the highest levels of arsenic will be collected by inert sampling procedures and analyzed for biotic and abiotic desorption tests.

- Biotic desorption test will consist of 5 closed flask with stressed conditions created by adding organic carbon and nutrients:

Flask 1:	Sterile Control
Flask 2:	Current Conditions, Winter (5° C)
Flask 3:	Current Conditions, Summer (20° C)
Flask 4:	Stressed Conditions, Winter (5° C)
Flask 5:	Stressed Conditions, Summer (20° C)

- Abiotic desorption test will consist of an upflow column with HBHA Pond soil overlain by HBHA Pond Sediment. The column will be run using site groundwater until steady state conditions are reached. Then, one or more of the following stressors will be added to the inflow to determine its/their effect

on arsenic desorption: Eh, pH, COD, Phosphorous and/or DO. These stressors will be varied to the degree likely to occur under conditions found in the study area.

Based upon the results of the initial 21 sediment samples, 3 representative sediment samples will be collected and analyzed for biodegradation tests. The tests will be conducted in accordance with the work plan presented in Appendix D of the Response to USEPA GSIP Phase 2 RI Draft Report Comments document, dated December 1997.

Section 2.0 HBHA Wetlands

The geochemical conditions, fate and transport of contaminants and natural attenuation mechanisms may cause metals to potentially release into ground water and surface water. These processes must be evaluated to determine their impact on migration, and if the conditions causing or arresting migration are permanent/reversible. This SOW will focus on understanding the natural attenuation mechanism within the HBHA Wetlands.

Sediment samples will be collected from 11 locations (3 areas: 2 areas with 3 samples/area; 1 area with 5 samples) within the HBHA Wetland as shown on Figure 2. Representative sediment samples will be collected with minimal disturbance and be analyzed for NAS Table 1 Sediment Delineation Parameters.

Based upon the results of the initial 11 sediment samples, 3 representative sediment samples will be collected by inert sampling procedures and analyzed for NAS Table 1 Sediment Geochemistry Parameters.

Based upon the results of the initial 11 sediment samples, 3 representative sediment samples will be collected to conduct batch arsenic adsorption tests using As (III) and the solids separated from each sample, and analyze pore water separated from each sample for As (III), As (V) and Organic Arsenic.

Based upon the results of the initial 11 sediment samples, 3 representative sediment samples containing the highest levels of arsenic will be collected by inert sampling procedures and analyzed for biotic and abiotic desorption tests.

- Biotic desorption test will consist of 5 closed flask with stressed conditions created by adding organic carbon and nutrients:

Flask 1:	Sterile Control
Flask 2:	Current Conditions, Winter (5° C)
Flask 3:	Current Conditions, Summer (20° C)
Flask 4:	Stressed Conditions, Winter (5° C)
Flask 5:	Stressed Conditions, Summer (20° C)

- Abiotic desorption test will consist of an upflow column with HBHA Wetland soil overlain by HBHA Pond Sediment. The column will be run using site groundwater until steady state conditions are reached. Then, one or more of the following stressors will be added to the inflow to determine its/their effect on arsenic desorption: Eh, pH, COD, Phosphorous and/or DO. These stressors will be varied to the degree likely to occur under conditions found in the study area.

Based upon the results of the initial 11 sediment samples, 3 representative sediment samples will be collected and analyzed for biodegradation tests. The tests will be conducted in accordance with the work plan presented in Appendix D of the Response to USEPA GSIP Phase 2 RI Draft Report Comments document, dated December 1997.

Section 3.0 Groundwater Plumes/Natural Attenuation Monitoring

Permanent cluster monitoring wells will be installed at each primary source (e.g. hide piles) to evaluate geo-chemical and source conditions. Groundwater samples will be collected from the top, middle, and bottom of the aquifer. Eh measurements will also be collected.

The data collected in Section 1.2.1 of the Final GSIP SOW, will assist in evaluating the fate and transport of the plumes and understanding their migration mechanisms. Based upon the results of the Final GSIP SOW, Section 1.2.1, permanent cluster monitoring wells will be installed along the centerline of the plumes (highest concentrations of arsenic, optimum geochemical parameters, toluene and benzene) and within each primary source (e.g. East-Central Hide Pile, South Hide Pile, as well as East and West Hide Piles) as a baseline to monitor the plumes concentrations, geo-chemical conditions, and their relationship. Groundwater samples will be collected from the top, middle, and bottom of the aquifer. Eh measurements will also be collected. These baseline wells will be monitored and sampled at fixed monitoring points (horizontally and vertically) over time to evaluate the natural attenuation mechanism/ conditions from "source to sink". A sufficient number of wells and comprehensive monitoring plan shall be required to understand the plumes and geochemical relationships, and their association with natural attenuation. Currently, it is envisioned that at least three (3) permanent monitoring well locations will be installed immediately downgradient of each of the primary sources, in addition to the source area permanent cluster monitoring wells. Dependent upon the Final GSIP SOW investigation results, additional permanent monitoring wells may be necessary.

NAS Table 1

Sediment Delineation Parameters

Field: Eh, pH, D.O., Specific Conductance, Temperature (vertical profile of water column)

Lab: Benzene
Toluene
Total Arsenic
Total Iron
Total Manganese
Total Organic Carbon
Total Inorganic Carbon

Sediment Geochemistry Parameters

Lab: EM Analysis (amorphous arsenic phases)
XRD Analysis (crystalline mineral phases)
XPS Analysis (arsenic oxidation states)
Sequential Extraction (adsorbed and precipitated arsenic)

Groundwater (site-related) Contaminants Of Concern (COCs)

METALS:
Aluminium;
Antimony;
Arsenic;
?? Barium;
Beryllium;
Cadmium;
Chromium;
Copper;
Iron;
Lead;
Manganese;
Nickel;
Selenium;
Vanadium;
Zinc;
Mercury (GSIP Requirement)

VOCs:
Toluene;
Benzene;
Xylenes;
Acetone;
Methylene Chloride;
Chloroform;
1,1-Dichloroethane
[1,1-Dichloroethene]
[Benzoic Acid]
? Trichloroethene;
? 111-Trichoroethane;
? 1,2-Dichloroethylene;

Semi-VOCs:
Bis(2-ethylhexyl)phthalate;
[2-methylphenol];
4-methylphenol;

Sediment (site-related) Contaminants Of Concern (COCs)

Note: PCB and pesticide data was validated as unusable. Any additional soil and sediment sampling should include PCB and pesticide analysis.

METALS: Arsenic;
Lead;
Chromium;
Mercury;
[Beryllium]
Cadmium;
Copper;
?? Manganese;
?? Antimony;
Nickel;
Zinc;

VOCs: Acetone;
Toluene;
Benzene;
Methylene chloride (low @ 6ppb on-site)
Tetrachloroethene (low @ 11 ppb on-site)
Trichloroethene (low @ 3 ppb on-site)
? Ethylbenzene;
?? 1,2-Dichloroethane

Semi-VOCs: Bis(2-ethylhexyl)phthalate;
[Diethylphthalate];
PAHs (acenaphthylene, anthracene, benzo (a) anthracene, benzo (a) pyrene, benzo (b) fluoranthene, benzo (g,h,i) perylene, benzo (k) fluoranthene, chrysene, fluoranthene, indeno (1,2,3-c,d) pyrene, phenanthrene, pyrene, dibenzo (a,h) anthracene, dibenzofuran, fluorene);
4-Methyl-2-pentanone

Surface Water (site-related) Contaminants Of Concern (COCs)

METALS:	Arsenic; Chromium; Lead; Mercury (required under GSIP); [Cadmium]; Copper; Iron; Silver; Zinc;
VOCs:	Toluene; Benzene; Methylene Chloride; 1,1-Dichlorethane; 1,2-Dichloroethylene; Trichloroethene;
Semi-VOCs:	Bis(2-ethylhexyl)phthalate; Phalates; [PAHs];

Soil (site-related) Contaminants Of Concern (COCs)

Note: PCB and pesticide data was validated as unusable. Any additional soil and sediment sampling should include PCB and pesticide analysis.

METALS:
- Arsenic; (used in 84' Risk Assessment)
- Lead; (used in 84' Risk Assessment)
- Chromium; (used in 84' Risk Assessment)
- Zinc; (identified in RI Phase 2)
- Copper; (identified in RI Phase 2)
- Mercury; (identified in RI Phase 2)
- Antimony; (identified in RI Phase 1)
- Barium; (identified in RI Phase 1)
- Cadmium; (identified in RI Phase 1)
- Nickel; (identified in RI Phase 1)
- Selenium; (identified in RI Phase 1)
- Silver; (identified in RI Phase 1)
- Thallium; (identified in RI Phase 1)

VOC/Semi-VOCs: Not consider a threat

FISH Contaminants Of Concern (COCs)

METALS: Arsenic
Chromium
Lead
Mercury

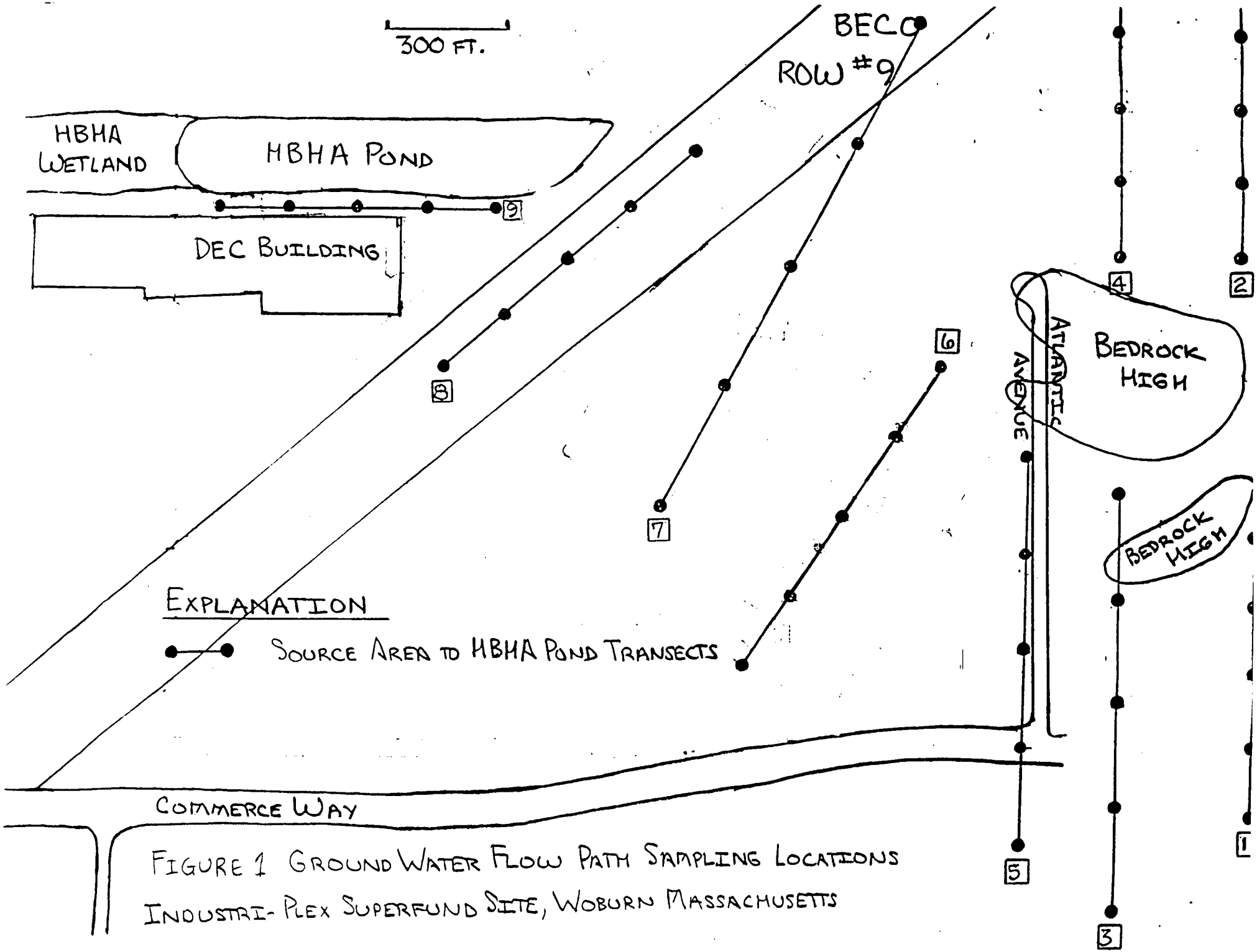
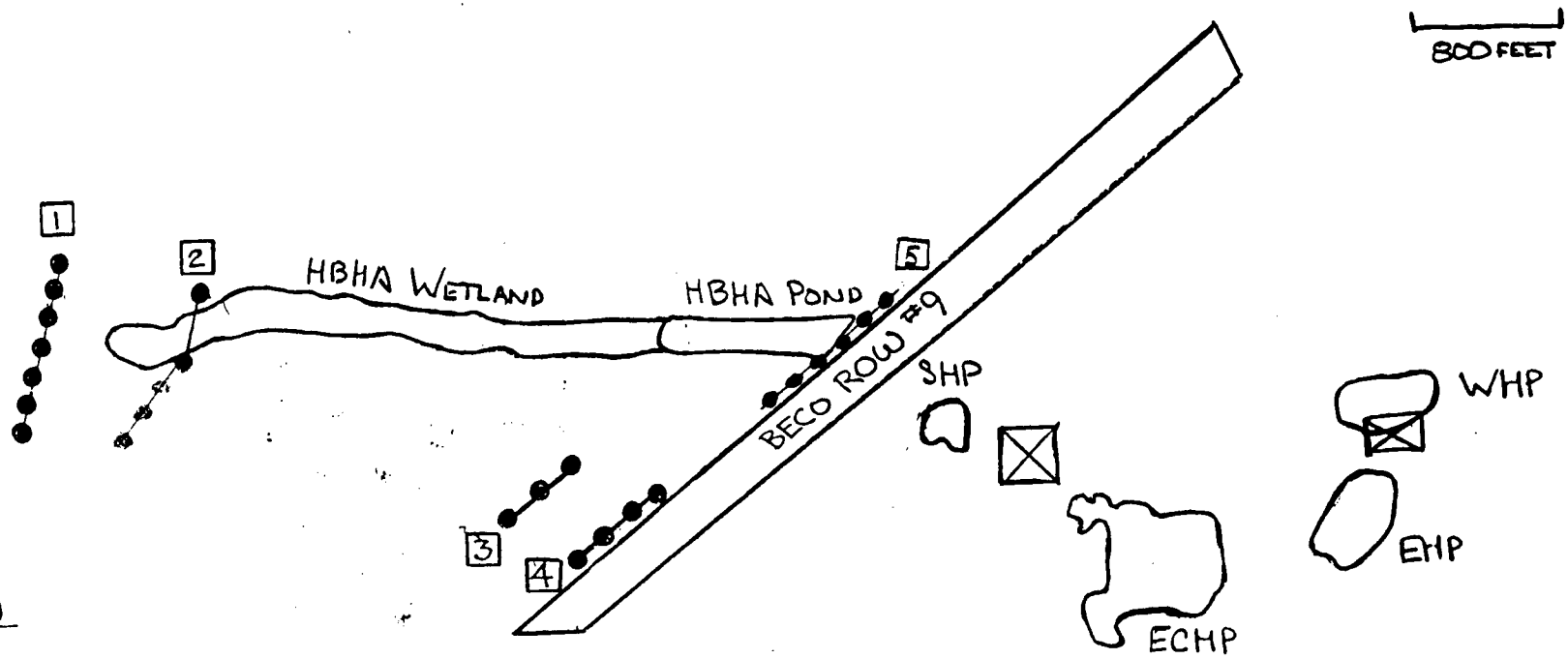


FIGURE 1 GROUND WATER FLOW PATH SAMPLING LOCATIONS
INDUSTRI-PLEX SUPERFUND SITE, WOBURN MASSACHUSETTS



EXPLANATION

⊠ BENZENE/TOLUENE SOURCE AREA INVESTIGATION

GEOPROBE®/MICROWELL® TRANSECT

1 TRANSECT 1 - MIGRATION TO GW-1 AQUIFER

2 TRANSECT 2 - MIGRATION FROM LAKE MISHAWUM

3 TRANSECT 3 - MIGRATION FROM # EAST END BECO ROW 9

4 TRANSECT 4 - MIGRATION FROM # EAST END BECO ROW 9

5 TRANSECT 5 - MIGRATION FROM WEST END BECO ROW #9

FIGURE 2. SOURCE AREA SAMPLING LOCATIONS (GROUND WATER) INDUSTRI-PLEX SITE, WOBURN, MA

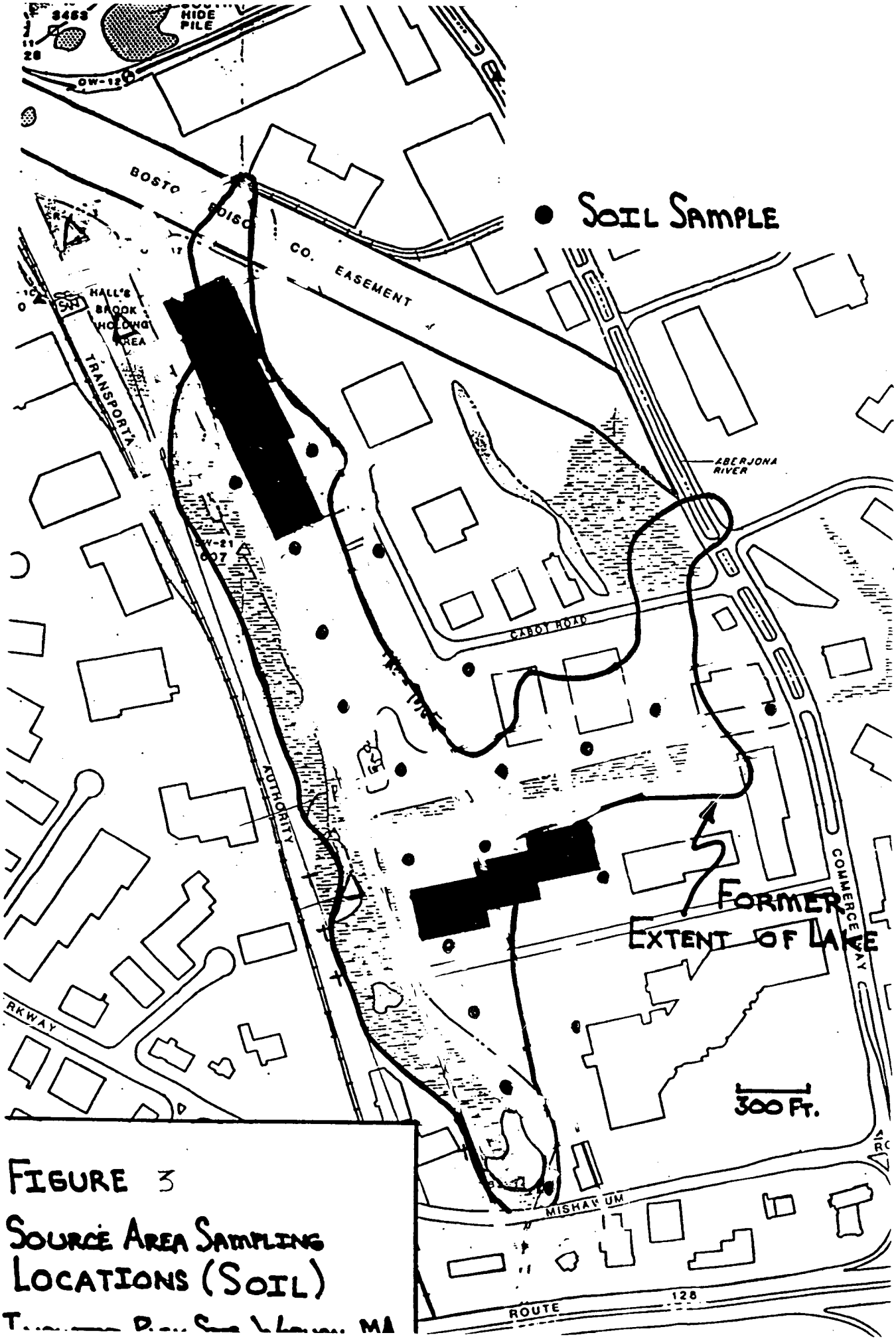


FIGURE 3

SOURCE AREA SAMPLING LOCATIONS (SOIL)

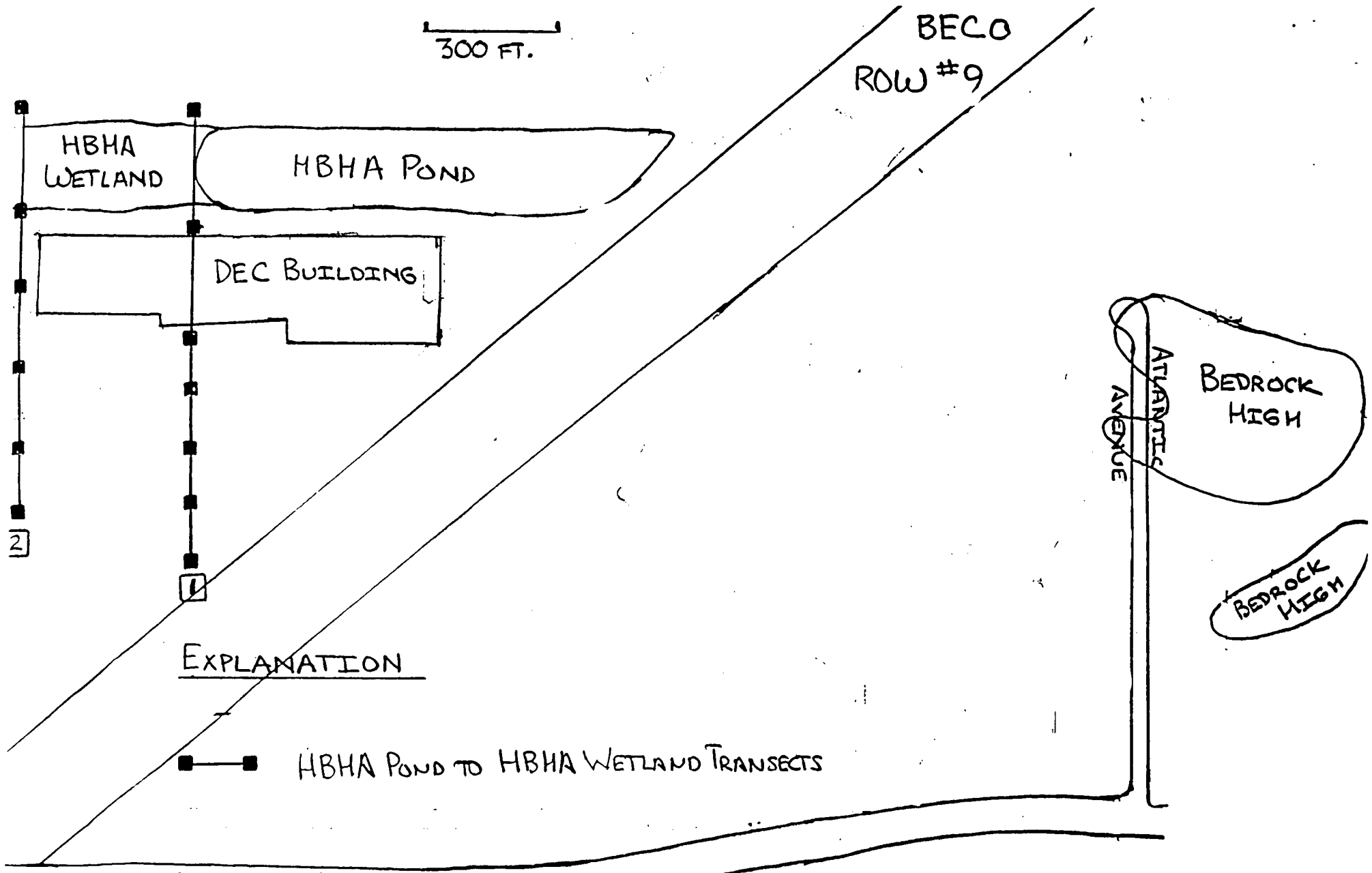


FIGURE 4 GROUND WATER FLOW PATH SAMPLING LOCATIONS
INDUSTRI-PLEX SUPERFUND SITE, WOBURN MASSACHUSETTS

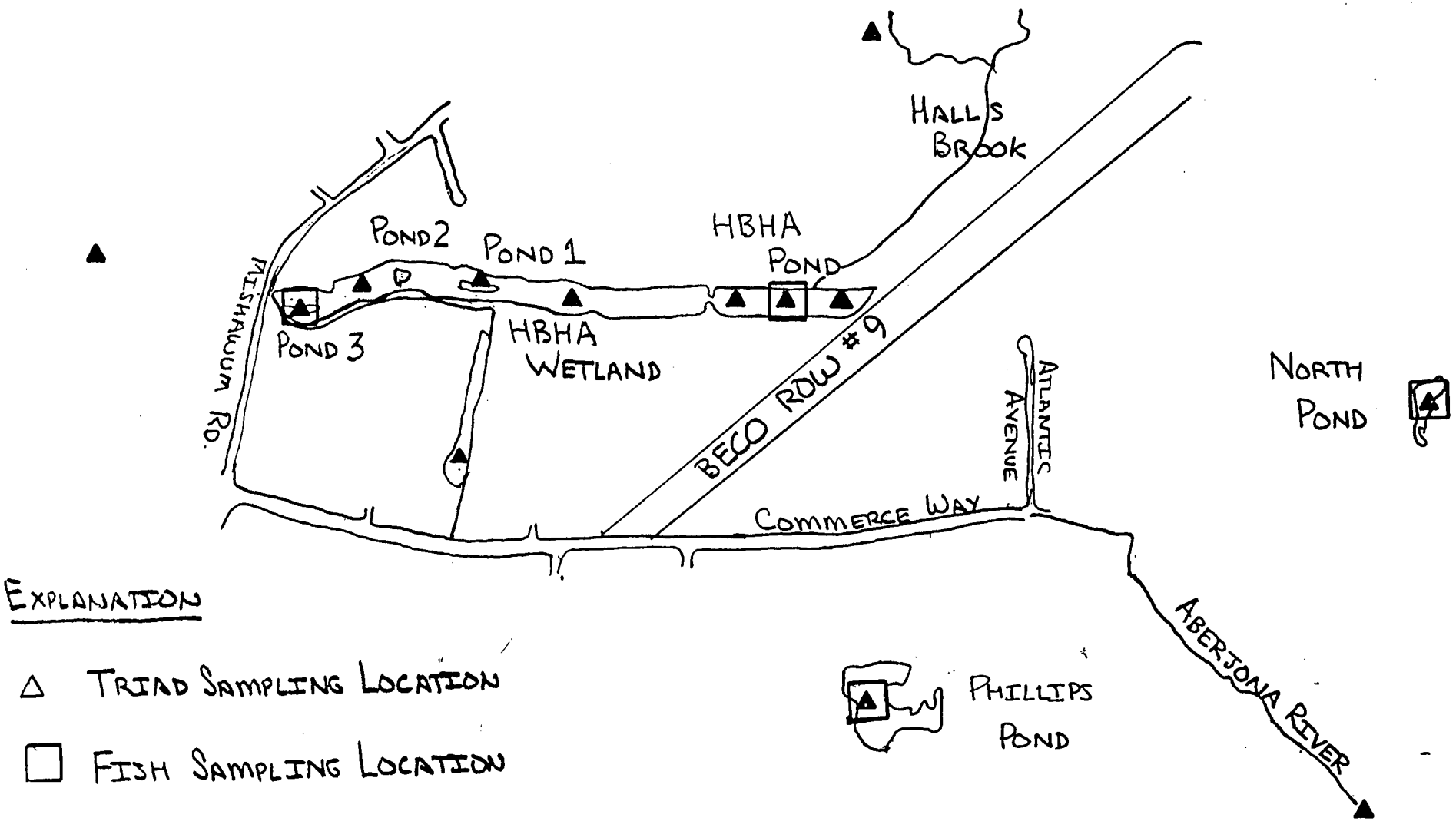


FIGURE 5

ECOLOGICAL IMPACT SAMPLING LOCATIONS

INDUSTRI-PLEX SITE, WOBURN, MA